(12) UK Patent Application (19) GB (11) 2 112 461 A

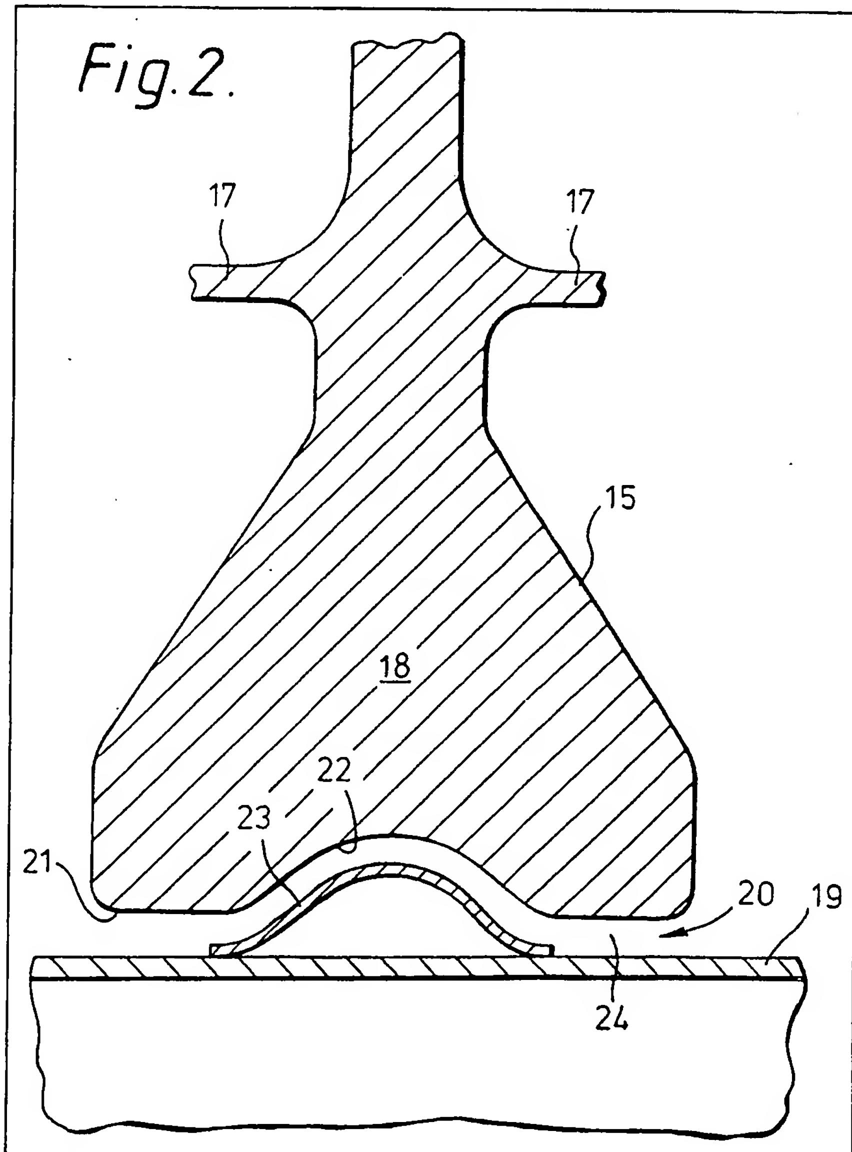
(21) Application No 8138542
(22) Date of filing 22 Dec 1981
(43) Application published 20 Jul 1983
(51) INT CL[3] F02C 7/12
(52) Domestic classification F1G 6
(56) Documents cited
GB 1600539
GB 1194663
GB 0836852
GB 0761435
GB 0340421
US 3742706
(58) Field of search F1G

(71) Applicants
Rolls-Royce Limited,
(Great Britain),
65 Buckingham Gate,
London SW1E 6AT.
(72) Inventors
Brian Henry Benfield
(74) Agent and/or Address for Service
M.A. Gunn,
Patents Department,
Rolls-Royce Limited,
PO Box 31,
Moor Lane,
Derby DE2 8BJ.

(54) **Turbine disc hub cooling means of a gas turbine engine**

(57) A rotor disc (15) has an axially enlarged hub portion (18) with a bore (20) through which a turbine shaft (19) extends in coaxial, radially spaced apart relationship. The hub portion (18) is provided with an annular open channel (22) in the bore (20) and an annular deflector (23) fixed on the turbine shaft (19) ensures that at least part of an axial temperature regulating air flow along the annular gap (24) between the turbine disc (15) and the turbine shaft (19) is deflected into the open channel (22). This reduces axial thermal gradients, and thus thermally induced stress, within the enlarged hub portion (18).

Fig. 2.



The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

GB 2 112 461 A

SPECIFICATION

Gas turbine engine turbine

This invention relates to a turbine suitable for a gas turbine engine.

The turbine of a gas turbine engine usually comprises at least one rotor disc which carries an annular array of turbine aerofoil blades. Such turbine rotor disc frequently have an enlarged hub portion which is of greater axial thickness than that of the remainder of the disc. Enlarged hub portions, are, however, prone to high axial thermal gradients particularly when the gas turbine engine in which they are incorporated is operating under aircraft take-off conditions. This gives rise to a large component of stress within the hub portion.

It is an object of the present invention to provide a turbine having a turbine rotor disc in which such axial thermal gradients, and thus the stress associated therewith, is reduced.

According to the present invention, a turbine suitable for a gas turbine engine comprises a rotor disc having a radially inner hub portion which is of greater axial thickness than the remainder of said rotor disc, a turbine shaft, said hub portion being provided with an axial bore therethrough whereby said rotor disc accommodates said turbine shaft in coaxial radially spaced apart relationahip, the radially inwardly facing surface of said axial bore which confronts said shaft having an open circumferential channel therein, means to provide a flow of temperature regulating fluid along the annular space defined between said shaft and said hub portion, and means to deflect at least a portion of said temperature regulating fluid flow into said circumferentially extending channel in said axial bore surface of said hub portion.

Said temperature regulating fluid detecting means is preferable attached to said turbine shaft.

Said temperature regulating fluid deflecting means may be centrifugally urged upon the rotation of said turbine shaft into a position in which it deflects said temperature regulating fluid.

Said temperature regulating fluid deflecting means may comprise an annular array of flap members, each pivotably attached to said turbine shaft so as to be centrifugally urged into positions in which they deflect said temperature regulating fluid.

Said temperature regulating fluid is preferably air.

The invention will now be described, by way of example, with reference to the accompanying drawings in which:

Figure 1 is a partially broken away side view of a gas turbine which incorporates a turbine in accordance with the present invention.

Figure 2 is an enlarged sectional side view of a portion of the turbine rotor disc and its associated turbine shaft visible in Figure 1.

Figure 3 is an alternative form of construction of the turbine rotor disc and turbine shaft shown in Figure 2.

With reference to Figure 1, a gas turbine engine generally indicated at 10 comprises, in axial flow series, a compressor section 11, combustion equipment 12, a turbine section 13 and a propulsion nozzle 14. The gas turbine engine 10 functions in the usual manner. Thus air drawn into the compressor section 10 is compressed before being mixed with fuel and the mixture ignited in the combustion equipment 12. The resulting combustion products expand through the turbine section 13 before being exhausted to atmosphere through the propulsive nozzle 14.

The turbine section 13 includes a turbine rotor disc 15 which is mounted for rotation therein and is provided with an annular array of aerofoil blades 16 around its periphery. The rotor disc h 15, which can be seen more easily in Figure 2, is provided with two axially extending flanges 17 on opposite sides thereof by means of which it is attached to adjacent rotatable structure (not shown). The radially inner hub portion 18 of the rotor disc 15 is, for reasons of strength, of greater axial thickness that the remainder of the disc 15. However, in order to accommodate a turbine shaft 19 which extends through the turbine 13 along the longitudinal axis of the engine 10, an axial bore 20 is provided within the hub portion 18 which is so positioned that the rotor disc 15 accommodates the turbine shaft 19 in a coaxial, radially spaced apart relationship.

The radially inwardly facing surface 21 of the bore 20 which confronts the turbine shaft 19 is provided with an open circumferential channel 22. The channel 22 is situated at the mid-point of the bore 20 so as to effectively equally divide the radially inner part of the hub portion 18. The portion of the turbine shaft 19 which is adjacent the channel 22 has an annular deflector 23 attached thereto. The deflector 23 extends partially into the channel 22 so that it deflects an axial airflow which passes in operation along the annular spaced 24 between the turbine shaft 19 and the rotor disc 15 into the channel 22.

The airflow passing along the annular space 24 is derived from the compressor section 11 of the gas turbine engine 10 and is arranged to be of such a temperature that it serves to assist in regulating the temperature of the rotor disc 15. However since the airflow is deflected into the channel 22 by the deflector 23, it also serves to reduce the axial thermal gradient across the hub portion 18 of the rotor disc 15. Such a reduction in the axial thermal gradient of the portion 18 results in turn in a reduction in the sub-surface stress in the core 20 and a general reduction of thermally induced stresses within the hub portion 18.

It is envisaged that alternative forms of deflector could be used to deflect the temperature regulating airflow into the channel 22. Thus for instance, the fixed deflector 23 could be replaced by a moveable deflector which is operative only when the gas turbine engine 10 is in operation. Such a deflector is shown in Figure 3 in which the turbine shaft 19 is provided with an annular array of deflector flaps 25, each of which is provided with a cylindrical root 26 which locates in a correspondingly shaped housing in the turbine shaft 19. As the shaft 19 rotates, the deflector flaps 25 pivot within their housings as they are centrifugally urged into the position shown in Figure 3. In that position they deflect at least some of the temperature regulating airflow passing through

the annular space 24 into the channel 22. It will be appreciated that with this type of deflector, gaps will exist between adjacent flaps 24 when they are in their operative positions. However a sufficient amount of the temperature regulating air is deflected into channel 22 to result in a reduction in the thermal gradients within the hub portion 18.

CLAIMS

1. A turbine suitable for a gas turbine engine comprising a rotor disc having a radially inner hub portion which is of greater axial thickness than the remainder of said rotor disc, a turbine shaft, said hub portion being provided with an axial bore therethrough whereby said rotor disc accommodates said turbine shaft in coaxial radially spaced apart relationship, the radially inwardly facing surface of said axial bore which confronts said shaft having an open circumferential channel therein, means to provide a flow of temperature regulating fluid along the annular space defined between said shaft and said hub portion, and means to deflect at least a portion of said temperature regulating fluid into said circumferentially extending channel in said axial bore surface of said hub portion.
2. A turbine as claimed in claim 1 wherein said temperature regulating fluid deflecting means is attached to said turbine shaft.
3. A turbine as claimed in claim 2 wherein said temperature regulating fluid deflecting means is centrifugally urged upon the rotation of said turbine shaft into a position in which it deflects said temperature regulating fluid.
4. A turbine as claimed in claim 3 wherein said temperature regulating fluid deflecting means comprises an annular array of flap members, each pivotally attached to said turbine shaft so as to be centrifugally urged into positions in which they deflect said temperature regulating fluid.
5. A turbine as claimed in any one proceeding claim wherein said temperature regulating fluid is air.
6. A turbine substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

Printed for Her Majesty's Stationery Office, by Croydon Printing Company Limited, Croydon, Surrey, 1983.
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.